Tram System Related Cycling Injuries

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Abstract:	Introduction Understanding of tram-system related cycling injuries (TSRCI) is poor. The aim of this study was to report the spectrum of injuries, demographics and social deprivation status of patients. Secondary aims included assessment of accident circumstances, effects of TSRCI on patients' confidence cycling, together with time off work and cycling. Methods A retrospective review of patients presenting to emergency services across all hospitals in a city with tram related injuries between May 2009 and April 2016 was undertaken. Medical records and imagining were analysed and patients were contacted by telephone. Results 191 cyclists (119 males, 72 females) were identified. 63 patients sustained one or more fractures or dislocations. Upper limb fractures/dislocations occurred in 55, lower limb fractures in 8 and facial fractures in 2. Most patients demonstrated low levels of socioeconomic deprivation. In 142 cases, the wheel was caught in tram-tracks, while in 32 it slid on tracks. The latter occurred more commonly in wet conditions($p=0.028$). 151 patients answered detailed questionnaires. Ninety-eight were commuting. 112 patients intended to cross tramlines and 65 accidents occurred at a junction. Eighty patients reported traffic pressures contributed to their accident. 120 stated that their confidence was affected and 24 did not resume cycling. Female gender($p<0.001$) and presence of a fracture/dislocation($p=0.012$) were independent predictors of negative effects on confidence. Patients sustaining a fracture/dislocation spent more time off work (median 5 days vs 1,$p<0.001$) and cycling (median 57 days vs 21,$p<0.001$).

	Conclusions TSRCI occur predominantly in young to middle-aged adults with low levels of socioeconomic deprivation, most commonly when bicycle wheels get caught in tram-tracks. They result in various injuries, frequently affecting the upper limb. Traffic pressures are commonly implicated. Most patients report negative effects on confidence and a sizeable minority do not resume cycling. TSRCI can result in significant loss of working and cycling days.

28/12/2017

Dear Sir/Madam,

Attached please find our submission entitled "Tram System Related Cycling Injuries". We hope that this will provide interesting and useful reading to the subscribers of Archives of Orthopaedic and Trauma Surgery and that it will raise awareness and understanding of these injuries and the effects that they have on cyclists.

Thank you for taking the time to review our work. We look forward to hearing from you in due course.

Kind regards,

Julian Maempel

Tram System Related Cycling Injuries

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Conflict of Interest: J Maempel, S Mackenzie, P Stirling, C McCann and T White declare that they have no conflict of interest. Professor C Oliver was a member and councillor of the Cyclists Touring Club Lothian and Borders and also the chair of the Road Share Steering Group based in Edinburgh, Scotland. He no longer holds these positions.

Tram System Related Cycling Injuries

ABSTRACT

Introduction

Understanding of tram-system related cycling injuries (TSRCI) is poor. The aim of this study was to report the spectrum of injuries, demographics and social deprivation status of patients. Secondary aims included assessment of accident circumstances, effects of TSRCI on patients' confidence cycling, together with time off work and cycling.

Methods

A retrospective review of patients presenting to emergency services across all hospitals in a city with tram related injuries between May 2009 and April 2016 was undertaken. Medical records and imagining were analysed and patients were contacted by telephone.

Results

191 cyclists (119 males, 72 females) were identified. 63 patients sustained one or more fractures or dislocations. Upper limb fractures/dislocations occurred in 55, lower limb fractures in 8 and facial fractures in 2. Most patients demonstrated low levels of socioeconomic deprivation. In 142 cases, the wheel was caught in tram-tracks, while in 32 it slid on tracks. The latter occurred more commonly in wet conditions(p=0.028).

151 patients answered detailed questionnaires. Ninety-eight were commuting. 112 patients intended to cross tramlines and 65 accidents occurred at a junction. Eighty patients reported traffic pressures contributed to their accident. 120 stated that their confidence was affected and 24 did not resume cycling. Female gender(p<0.001) and presence of a fracture/dislocation(p=0.012) were independent predictors of negative effects on confidence. Patients sustaining a fracture/dislocation spent more time off work (median 5 days vs 1,p<0.001) and cycling (median 57 days vs 21,p<0.001).

Conclusions

TSRCI occur predominantly in young to middle-aged adults with low levels of socioeconomic deprivation, most commonly when bicycle wheels get caught in tram-tracks. They result in various injuries, frequently affecting the upper limb. Traffic pressures are commonly implicated. Most patients report negative effects on confidence and a sizeable minority do not resume cycling. TSRCI can result in significant loss of working and cycling days.

KEYWORDS: cyclist; cycling; tram; tram-system; streetcar; light rail; fractures; injuries

INTRODUCTION

Cycling is increasingly promoted by public health and transportation authorities as an environmentally friendly mode of transport with health[1-3] and economic[4] benefits[5]. As a result, cycling is rapidly increasing in popularity, both for leisure and work commuting[6;7] and cycling-related injuries are also becoming more common[8].

Trams (often referred to as streetcars in America) are an efficient form of light rail public transport and the catchment areas served by trams and their usage worldwide has increased significantly in recent years[9;10]. Passenger numbers on tram and light rail networks in England have increased by around 50% over the last decade[10] and the year on year trend of increasing passenger numbers continues in various countries[9;10], yet understanding of tram related injuries remains poor, despite reports of increasing incidence of both emergency department presentations and major trauma resulting from tram-related injuries[9;11].

Cyclist injuries have been reported to account for up to 46% of tram related injuries[12] and yet there is a particular lack of published data in the medical literature relating to tram system related cyclist injuries (TSRCI), with only a handful of studies making any mention of these[11;12] and none reporting specifically on

the patient demographics or injuries sustained by cyclists in this regard, or the impact of these incidents on cyclists.

Road safety is a current priority of the United Nations, whose general assembly has declared 2011 to 2020 the decade of Action for Road Safety (directive A/RES/64/255, 10th May 2010) on the basis of reports by the World Health Organisation[13].

A better understanding of the injuries sustained, the mechanism of injury and the population at risk would potentially facilitate targeted interventions to prevent or reduce the incidence of these injuries and would also be useful to health providers and transport safety authorities in areas serviced by trams and areas where tram systems are being considered.

The aim of this study was therefore to review all patients presenting to hospitals in our region with tram system related injuries and to report the spectrum of injuries encountered, the demographics and social deprivation status of patients sustaining these injuries and mechanisms of injury. Secondary aims included assessment of circumstances of incidents resulting in these injuries and the effects of TSRCI on patients' confidence and ability to return to cycling activities, the time spent off work and cycling activity and factors influencing these.

METHODS

A retrospective review of trust-wide electronic patient records was undertaken and all patients presenting to (*INSTITUTIONS BLINDED*) emergency services across three hospital sites covering the city of (*CITY BLINDED*) and surrounding suburbs as well as (*BLINDED LOCATION*), with injuries related to the tram system between May 2009 and April 2016 were identified. All patient records for acute services at our trust are electronic. Two hundred and fifty one patients who suffered injuries in relation to the tram system during this time period were identified. Of these, 191 suffered such injuries while riding a bicycle and form the cohort under review in this study.

Patient medical records, imaging studies and operation notes were reviewed. Patient demographics, injuries, treatments and procedures were recorded. The number of outpatient appointments, imaging studies and procedures were also documented. Patient postcodes were used to determine their social deprivation status using the Scottish Index of Multiple Deprivation (SIMD). The SIMD is an official Scottish government

resource that takes into account employment, income, crime, housing, health, education and access to services, to assess and classify population socioeconomic deprivation status for the whole country. The country is divided into over 6,500 datazones, each comprising a small geographical area with between 500 and 1,000 residents. Each datazone is ranked by its socioeconomic deprivation status based on the above criteria. Patients were then contacted by telephone and asked to provide details about the circumstances of the incident (visibility, weather conditions, purpose of their journey, traffic related questions), time spent off work as a result of their injury and the effect that the incident has had on their confidence with cycling and ability to return to cycling. The amount of time spent off cycling as a result of the incident was also recorded.

Statistical analysis was undertaken using Statistical Package for Social Sciences (SPSS) (Version 20.0, IBM Corporation, Armonk, New York). Mean values for normally distributed continuous data were compared using two-tailed Student *t*-tests. Median values for non-normally distributed continuous data were compared using the Mann–Whitney U test. Chi-squared tests were used to analyse nominal variables, except where the expected cell count in any cell was <5, when Fisher's Exact test was used instead. Spearman's rank correlation coefficient was used for bivariate correlation. Where multiple predictors of nominal variable outcome were identified on univariate analysis, binary logistic regression analysis was undertaken to determine which factors were significant predictors of the dependent variable. A p-value <0.05 was considered statistically significant.

RESULTS

One hundred and nineteen males and 72 females (total 191 patients) presented to acute services with cycling injuries relating to the tram system during the time period under review. Male patients (mean age 39.5±12.9 years) were older than female (33.8±11.0) patients (p=0.001). Patients presenting with injuries related to the tram system were distributed disproportionately to the upper end of the social deprivation scale, indicating low levels of social deprivation (figure 1).

Two mechanisms of injury accounted for the vast majority of patients presenting with tram system related cycling injuries. The commonest mechanism of injury was getting the bicycle wheel caught in the tram track (142) while the second commonest was the wheel sliding on a tram track (32). Accidents due to wheels sliding on the tram tracks were more likely to occur in wet conditions than those due to wheels getting caught in the tram tracks (p=0.028). One person collided with a tram and in 15, there was another mechanism or the exact

mechanism was not documented. There was no demonstrable association between mechanism of injury and patients undergoing a procedure for their injury (p=0.172).

A list of injuries encountered (excluding simple bruises, lacerations and abrasions) is provided in table 1. Sixty three patients sustained a fracture or dislocation. Fifty five patients sustained upper limb fractures or dislocations and one each of these sustained a rotator cuff tear and a mallet finger in addition to their upper limb fracture/dislocation. Eight patients sustained lower limb fractures and two sustained facial fractures. One of these sustained simultaneous upper and lower limb fractures and one sustained facial and lower limb fractures while four patients sustained more than one upper limb fracture/dislocation.

Thirty two patients underwent 35 procedures as a result of their injuries (table 2). Patients who sustained a fracture or dislocation as a result of their accident were more likely to have undergone a medical procedure (OR 6.33, 95%CI 2.77-14.49) as a result of their TSRCI (22 of 63) than those who did not (10 of 128, p<0.001), but there was no difference in the proportion of upper or lower limb fracture/dislocations patients requiring interventions (p=1.0, Fisher's Exact Test).

In total, the injuries sustained by 191 patients who sustained TSRCI during this period accounted for 192 A&E attendances. After preliminary treatment in A&E, 58 patients were referred for orthopaedic outpatient follow up, one for outpatient ENT followup, one for outpatient maxillofacial followup, 17 were admitted to the orthopaedic department, three were referred directly for outpatient physiotherapy and 112 were discharged directly from A&E. Patients seen in fracture clinic (by direct referral or following admission) attended a median of 2 fracture clinic appointments per patient (IQR 2 appointments, range 1-13). One hundred and thirty six patients underwent 5 CT and MRI scans and 730 xrays (individual exposure ranged from 0 to 28 radiographs) while 55 did not have an xray.

Patient Followup

At the time of telephone followup, 156 patients (81.7%) were accounted for (81.7%). 151 patients replied to the questions, 4 patients declined to participate in the study and 1 was deceased. Thirty five patients (18.3%) could not be contacted and were considered lost to follow up.

Ninety eight patients were commuting at the time of the accident, while 53 were cycling for leisure purposes. Of the 53 who were cycling for leisure purposes, 9 were students, 6 were not currently employed (one on medical grounds) and 3 were retired while the rest were actively employed. Accidents involving work

commuters (82 of 98) were more likely to occur between Monday and Friday (odds ratio 2.86, 95%CI 1.32 to 6.22, *p*=0.007) than those involving leisure riders (34 of 53) (figure 2). Visibility was reported to be good in 141 and poor in 10 cases while weather conditions were reported to be wet in 83 cases and dry in 68.

Sixty five of 151 patients (43%) reported that their accidents occurred at a junction while 86 were not at a junction (57%). One hundred and twelve patients (74.2%) reported that they were intending to cross the tramlines at the time of the incident. Of the 112 patients who intended to cross the tramlines, 57 (50.9%) reported that they felt traffic pressures made positioning themselves to cross the tramlines more difficult. Of the 39 who were not intending to cross the tramlines at the time of their accident, 23 (59%) reported that they were forced into the tramlines due to traffic pressures, whilst 16 were merely riding adjacent to them. Of 151 respondents, 80 (53%) therefore reported that traffic pressures contributed to their accident.

Of the 151 respondents, 24 (15.9%) did not return to cycling after their accident while 127 did return to cycling. Males (84 of 95) were more likely than females (43 of 56) to return to cycling (odds ratio 2.31, 95%CI 0.96-5.58, *p*=0.059). Thirty one patients (20.5%) reported that their confidence cycling had not been affected while 120 (79.5%) stated that their confidence had been affected and of these, 9 reported that they were no longer confident cycling (figure 3). Amongst those who did return to cycling, confidence was diminished. Females (54 of 56) were more likely than males (66 of 95) to report that their confidence cycling had been effected (OR 11.86, 95% CI 2.71 to 51.98, p<0.001), but patient age was not related to confidence (p=0.82). Patients who sustained a fracture or dislocation as a result of their TSRCI were also more likely (42 of 47, 89.6%) than those who did not (78 of 104, 74.8%) to report that their confidence cycling had been negatively affected (OR 2.8, 95%CI 1.002-7.83; p=0.043). Implication of traffic pressures in the accident was not predictive of an effect on cyclist confidence (*p*=0.318). Both female gender (p<0.001) and presence of a fracture/dislocation (p=0.012) were found to be independent predictors of negative effect on confidence cycling upon binary logistic regression statistical analysis.

Median time off work was 1 day (IQR 7) and median time to return to cycling was 30 (IQR 74) days (*p*<0.001, Related Samples Wilcoxon Signed Rank Test). Patients who sustained a fracture or dislocation took longer to return to work (median 5 days off work, IQR 42 days vs 1 day, IQR 3 days; p<0.001) and to cycling activities (median 57 days off cycling, IQR 96 vs 21 days, IQR 34; p<0.001). Gender (p≥0.41), patient age (p≥0.182) and mechanism of injury (p≥0.472) did not affect the time to return to either of these activities.

DISCUSSION

Tram system related cycling incidents result in a wide spectrum of injuries and place additional burdens on local acute healthcare providers. The upper limb is most commonly affected. Collisions are rare and the vast majority of incidents are due to bicycle wheels getting caught in the tram tracks, with sliding of the wheels over the tracks being the second commonest mechanism of injury. Most injuries occurred during a work commute and a significant proportion of patients do not return to cycling. More than half of respondents reported that traffic pressures contributed to their accident and the vast majority of respondents reported that the incident affected their confidence cycling. Young adult and middle aged individuals were most commonly affected and TSRCI were observed much more commonly in patients with low levels of socioeconomic deprivation. TSRCI resulted in loss of both working days and cycling days.

Patient demographics

We noted TSRCI to be more common in males and the majority of injuries occurred in individuals aged 20 to 50 years. These findings are in keeping with the findings of other studies of cycling related injuries in general[8] and TSRCI[12]. Tschenke et al, in a smaller study of 87 patients, reported a similar age distribution, but found TSRCI to be commoner in females[14]. This is the first study to examine the relationship between social deprivation and TSRCI. TSRCI demonstrated a strong inverse correlation with social deprivation, such that these injuries were encountered much more commonly in patients with low levels of socioeconomic deprivation than in those who are most deprived (figure 1). These results have to be interpreted in the context of the population served by the hospitals included in this study, which generally has lower levels of deprivation that the nation as a whole[15]. However, the observed trend is in striking contrast with that for fractures in general in the same region, which exhibit a strong *positive* correlation with increasing levels of social deprivation[15]. Establishing the reasons for this observed relationship was beyond the scope of this study, however may relate to known strong links between affluence and cycle ownership[16] and cycling for both leisure and commuting[17]. Furthermore, studies have shown that observed increases in commuter cycling in recent years were greater in less deprived cohorts[6].

Injuries Encountered

The vast majority of fractures and dislocations sustained by cyclists in TSRCI were of the upper limb. This is in keeping with a previous, smaller report by Cameron et al[12] where 15 of 20 fractures sustained by cyclists in tram-related incidents were of the upper limb. Other studies have previously noted that upper extremity injuries were common among cyclists[18;19]. Of fifty five patients with upper limb fractures or dislocations in our

study, 19 underwent one or more procedures relating to their upper limb injury, indicating that most of these injuries were managed conservatively. Similarly, three of 8 patients with lower limb fractures required surgery. The majority (58.6%) of patients were discharged directly after first presentation to A&E (other studies of tram related injuries, which were not specific to cyclists, reported similar findings[11;12]). However, 17 patients were directly admitted (all to orthopaedics) and 63 patients were referred for ongoing outpatient care, with the majority of these (58, ie 92%) followed up in fracture clinics. TSRCI therefore place significant burdens on A&E and trauma and orthopaedic services. These must be considered when designing services in towns serviced by trams and also accounted for when new tram systems are planned and constructed.

The spectrum of injuries encountered was wide, ranging from simple contusions to hip and humeral fractures. Fractures around the elbow were particularly common. This study is unique in the level of detail provided regarding injuries and procedures sustained by cyclists in relation to tram systems. Other studies are limited to simply reporting the body region injured (without specific details of injuries encountered)[11] or do not describe the injuries at all[14] while most focus on tram related injuries in general[11;12], making only brief mention of injuries to cyclists[12]. Most patients sustained minor injuries and this finding was in keeping with those of other studies undertaken in the context of tram related injuries in general[11;12], however, a number of more serious injuries were encountered, some of which required surgery. Surgery is not strictly limited to treatment of the acute injuries themselves, but occasionally also to sequelae of these: one patient who underwent distal radius fixation developed acute carpal tunnel syndrome requiring subsequent decompression.

Injury circumstance

Cycling injuries accounted for the majority (76.1%) of tram system related injuries in our institution and similar findings have been reported by others in the UK[12]. The local tram system consists of an 8.7 mile tram route, of which approximately 1.4 miles is on shared-use roads with no physical segregation of cyclists from trams. Collisions with trams are rare[11]. Only one such incident was encountered in this study and none in another study[14]. Our findings in this regard may have been influenced by the fact that the tram system itself was not operational in the early years of this study, despite the tracks being laid, however, In keeping with other, smaller studies[12;14], the commonest mechanism of TSRCI in this study was cycle wheels getting caught in the tram tracks. Tram wheels ride on the rail surface and are held in position by a larger diameter flange on one side of the wheel, which rides in the flangeway (a slot beside the rail)[14]. It is within this flangeway that cycle wheels can get caught and studies have shown that standard tire widths for bicycles vary widely, but commuter and city

bikes tend to have tires at the lower end of this spectrum, averaging around 34.4mm[14] and many are narrow enough to get caught in tram tracks. Novel prototype devices have been designed that are placed in the tram tracks and depress under the weight of a tram but not a bicycle in an attempt to prevent such accidents, but these are not yet commercially available[20]. The second most common mechanism of injury (albeit significantly less common), in keeping with the findings of Teschke et al[14], was sliding of wheels on the metal tracks. Respondents indicated that wet conditions were significantly commoner in this type of injury than when wheels got caught in the tracks and this is not unexpected, given that wet surfaces are more slippery. Cyclist education is a key component of any potential campaigns to reduce TSRCI and cyclists should be warned to be even more vigilant of this mechanism of injury in wet conditions.

Over half of respondents (53%) indicated that motor traffic pressures had contributed to their incident while over 74% stated that they were attempting to cross the tramlines at the time of the incident. These findings highlight one of the major issues of mixed transport modes sharing road surfaces. Other authors have reported that the odds of cyclists being injured increased significantly when cycling on segments of road with tram tracks[21;22], with one group reporting the odds to increase by a factor of three times[21]. The risks are further increased by other factors such as on-street parked cars, the absence of dedicated cycling infrastructure[14] and heavy traffic[22]. Segregation of cyclists has been advocated by some[1;14;22] and it has been suggested that dedicated cycle tracks may lower the odds of incidents more significantly than simple cycle lanes, although cycle lanes are still effective at reducing the incidence of incidents compared to mixed traffic[14]. Many urban tram systems[11;22], including the one featured in the present study, feature segments of track shared with cyclists and road users[14;21;22]. Intersections also represent a significant problem for cyclists[22]. Just under half of the incidents in our study occurred at a junction and it has been suggested that these incidents could be prevented by introducing ‘protected junctions’ which enforce two stage turns for cyclists and facilitate crossing tram-lines at right angles, although these may have implications on efficiency of traffic flow[14].

Some authors have called for targeting of safety initiatives to specific at-risk patient groups[11]. The identification of specific groups of individuals who appear to be more frequently involved in TSRCI (eg commuters, demographic patterns and patterns of socioeconomic deprivation) in this study facilitates a better understanding of the population at risk of these injuries and may be helpful in the targeting of campaigns and cyclist education to prevent such injuries. However, other authors have suggested measures such as use of

wider tires and also stated that any preventive measures must be combined with improvements in cycling infrastructure and traffic management[14].

Effects on cycling confidence, return to cycling and work

One of the strengths of this study is the high rates of patient contact for followup and therefore the ability to report on the patient's perspective, which is increasingly recognised as an important measure of outcome[23]. Patients have previously been contacted in the context of studies on road safety[14], but not in medical studies of TSRCI. Almost two thirds of patients in this study reported that the incident occurred while commuting. It is perhaps unsurprising that injuries to commuters were found to be more likely to occur during the working week than those to leisure cyclists. Other authors have also reported that commuters made up a significant proportion of injured cyclists in TSRCI[14]. Of 151 respondents, 142 persons (94.04%) were either employed or students. These injuries therefore result in costs not only to healthcare providers, but also have a significant potential for economic impact, both directly to those involved but also to employers and the wider economy. Furthermore, TSRCI may result in delays to the tram service, although assessment of these was not within the scope of this study. At a minimum, these individuals had to attend A&E, and a significant proportion then missed time from work. The median number of days off work for the group as a whole was 1 day, but this rose significantly ($p<0.001$) to 5 days for patients sustaining any fracture or dislocation as a result of their TSRCI. Time off work was not affected by patient gender, age or mechanism of TSRCI. Furthermore, in some patients, a substantial time off work was registered, with 17 individuals missing more than one month of work, one individual missing 196 days of work and another still unable to return to work as a horse carer over 2 years after their injury at the time of followup. Return to work and sporting activity are important measures of outcome, particularly in younger populations[24]. These may reflect important milestones or targets for patients after injury and may also have economic consequences for both patients and employers.

Return to cycling tended to occur after return to work ($p<0.001$), mirroring trends observed in the context of elective hip replacement surgery, where return to work tended to precede return to sporting activities[24]. Furthermore, while only one respondent had not returned to work after their TSRCI, almost 16% (around 1 in 6) of respondents stated that they did not return to cycling by the time of followup. This represents a significant minority of patients and the negative repercussions of failure to return to cycling impact both individual patients (who will miss out on the reported health benefits of regular cycling)[1-3], as well as society in general (due to potential consequences on the environment, economy[4] and road traffic congestion[5]). Females appeared to

be less likely than males to return to cycling after TSRCI, although this finding was just outside statistical significance (p=0.059). This is in keeping with observations by other authors of return to sporting activity in the context of ankle fractures[25] and long-term injuries[26].

The overwhelming majority of respondents (around 4 in 5 or 79.5%) stated that their confidence in cycling had been negatively effected by their TSRCI. Thus, the effects of TSRCI on cyclist confidence and return to cycling are significant and should not be underestimated. Given the frequency of TSRCI, large numbers of cyclists could potentially be put off returning to cycling or have less confidence when cycling and this number may be even higher when one considers the indirect effects of TSRCI on cycling, for example through riders injured in TSRCI sharing their experiences with other riders or individuals who are considering taking up cycling. These effects were not assessed in this study. Female gender and sustaining a fracture or dislocation were confirmed to be independent predictors of negative effects on confidence when cycling upon binary logistic regression. However, those who stated that traffic pressures were contributory were not found to be more likely to report loss of confidence cycling.

Limitations

This study has limitations, including its retrospective nature and the loss to followup of some patients. However, loss to followup of some patients is almost inevitable in retrospective studies and the reported followup rate is relatively high. Furthermore, this is the largest reported series of TSRCI and the only study to discuss in detail the injuries sustained by these patients and the effects on their confidence, absence from work and cycling. The use of binary logistic regression analysis when more than one variable was predictive on univariate testing is an additional strength of this study and was facilitated by the size of the cohort in this study.

CONCLUSIONS

TSRCI occur most commonly when bicycle wheels get caught in, or slide over, tram tracks. Collisions are rare. TSRCI result in a wide spectrum of injuries, ranging in severity from simple contusions to serious fractures requiring surgery. The upper limb is most commonly affected. These injuries were most commonly observed in patients with low levels of socioeconomic deprivation. A sizeable minority of patients do not return to cycling while the vast majority report that their confidence in cycling is negatively effected. TSRCI occurred predominantly in a working population and can result in significant loss of working days. Respondents indicated that traffic pressures were directly involved in more than half of cases. Females were more likely to

report that their confidence had been affected, while the presence of a fracture or dislocation predicted longer time off work and cycling and a negative effect on confidence in cycling.

FIGURE AND TABLE CAPTIONS

Fig 1 Numbers of individuals presenting to acute services across all sites with injuries relating to the tram system, according to their quintile in the Scottish Index of Multiple Deprivation. The 5th quintile represents the least socially deprived individuals and the first the most socially deprived

Fig 2 Bar chart showing day of accident for patients who were commuting to work and those who were riding for leisure

Fig 3 Pie chart showing self-reported effect on the TSRCI on patient's confidence cycling

Table 1 List of injuries by anatomical region. Simple bruises or lacerations are not included. *The elbow dislocation was associated with a radial head fracture included in the total number of radial head fractures.

Table 2 Procedures undertaken in patients sustaining tram related cycling injuries. Thirty two patients underwent 34 procedures

ETHICAL APPROVAL. For this type of study formal consent is not required. The study was registered locally as an audit of service.

INFORMED CONSENT. All patients contacted by telephone to answer questions regarding the circumstances of their incidents, effects on confidence, cycling and return to work were asked for informed consent to include their responses in the study prior to asking them any questions. 4 patients declined and did not therefore respond to the questions. The responses from the remaining patients who gave consent were included in the manuscript.

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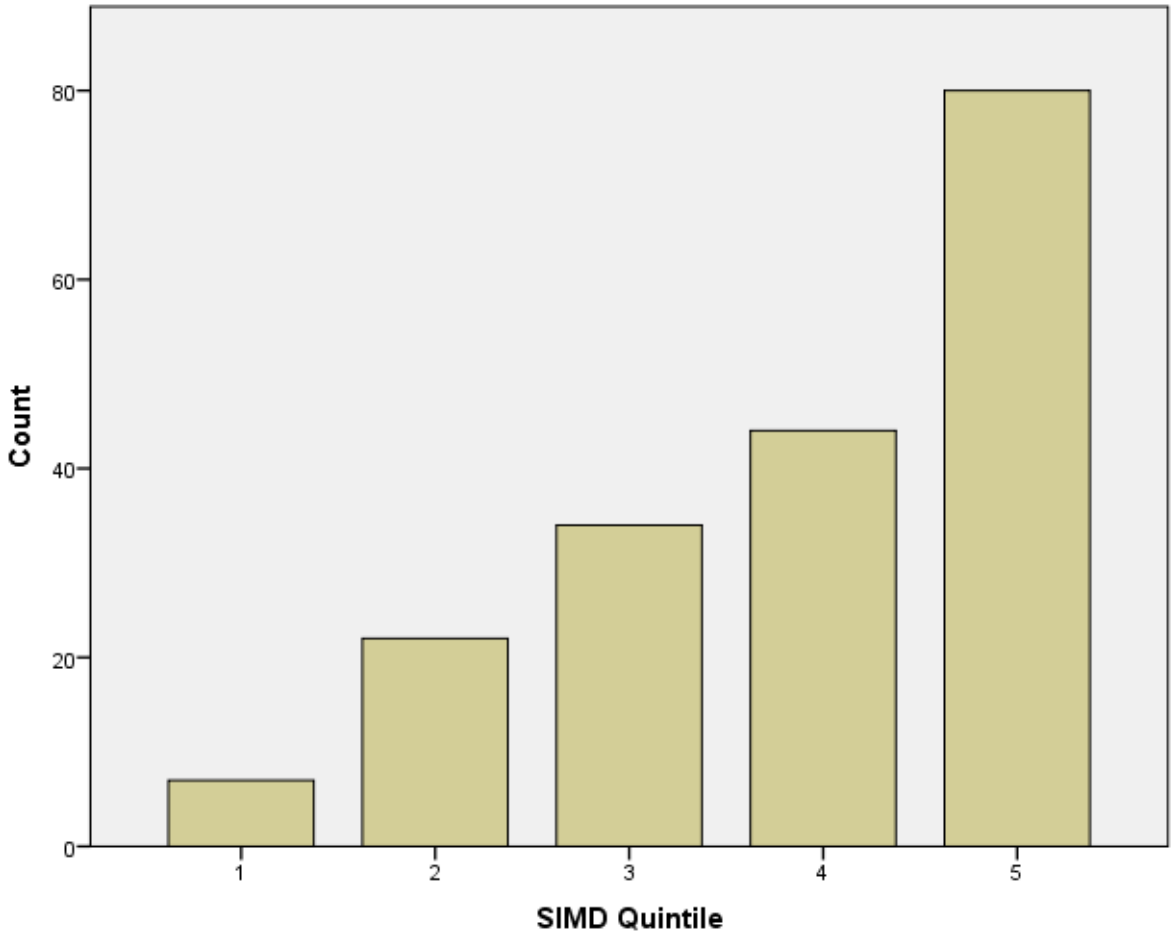
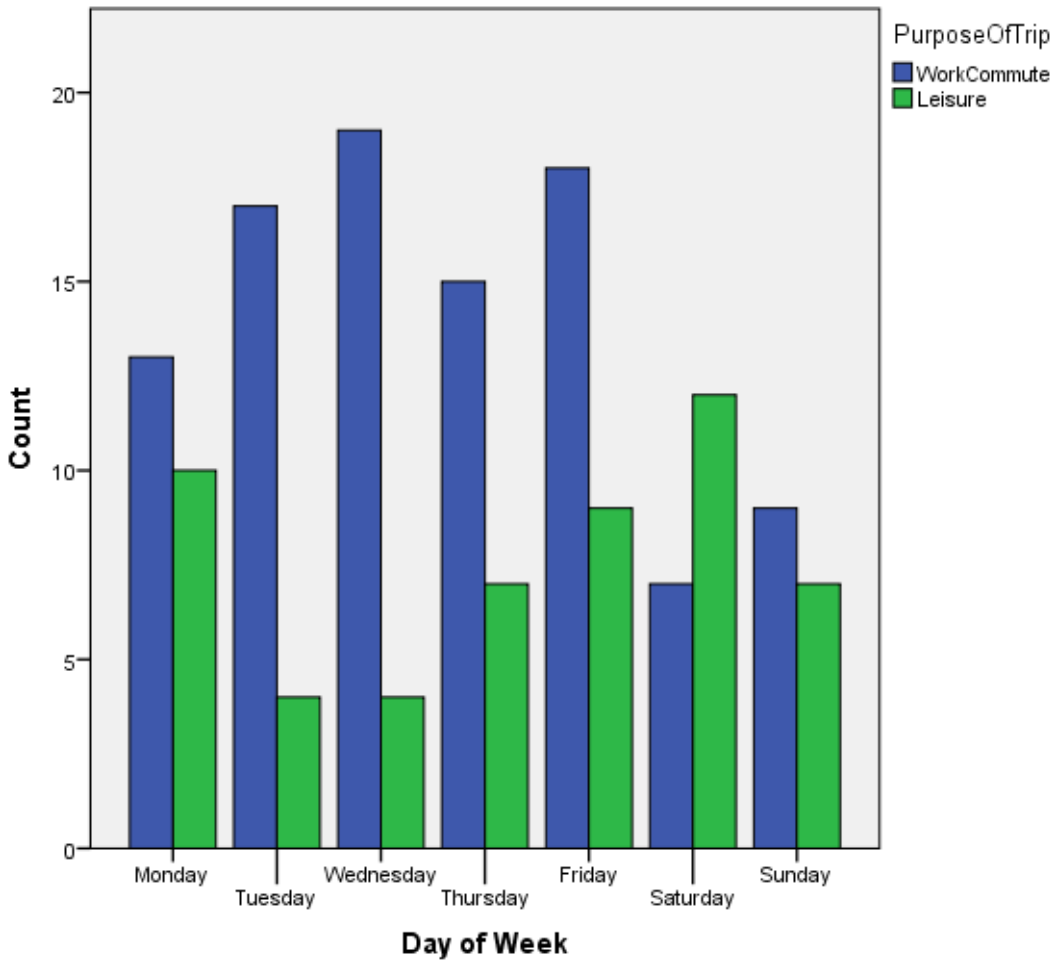
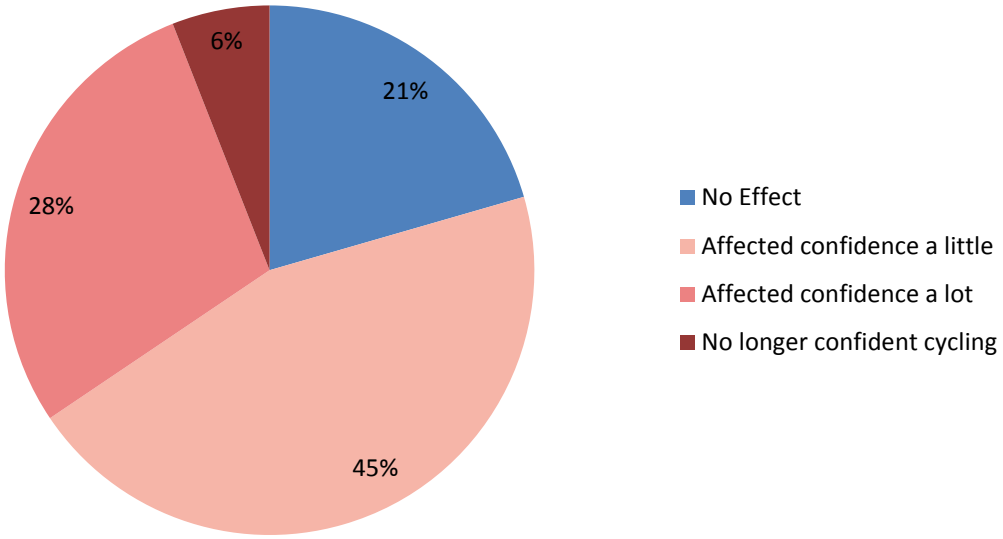
Figure



Figure


PurposeOfTrip
WorkCommute
Leisure
Count
20
15
10
5
0
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of Week

Figure


6%
21%
28%
45%
No Effect
Affected confidence a little
Affected confidence a lot
No longer confident cycling

Table

Anatomical region	
Head injury – minor	35
Head injury with loss of consciousness	1
Nasal fracture	1
Mandibular fracture	1
Acute abdominal wall herniation	1
Clavicle fracture	4
Acromioclavicular joint dislocation	2
Rotator cuff tear	1
Proximal Humerus fracture	4
Humeral shaft fracture	2
Capitellar fracture	1
Radial head fracture	16*
Olecranon fracture	2
Elbow dislocation	1*
Radial shaft fracture	1
Distal radius fracture	9
Ulnar styloid fracture	1
Scaphoid fracture	1
Triquetrum fracture	4
Metacarpal fracture	4
Phalangeal fracture	4
PIPJ dislocation	3
Mallet finger	1
Intracapsular hip fracture	1
Extracapsular hip fracture	1
Tibial plateau fracture	1
Patellar fracture	1
Ankle fracture	1
Navicular fracture	1
Metatarsal fracture	2

Table 1 List of injuries by anatomical region. Simple bruises or lacerations are not included. *The elbow dislocation was associated with a radial head fracture included in the total number of radial head fractures.

Table

Procedure	Number
Nasal fracture MUA	1
Rotator cuff repair	1
Distension arthrogram for frozen shoulder after undisplaced proximal humeral fracture	1
Distal Humerus ORIF	1
Olecranon ORIF	2
Removal of metalwork following olecranon ORIF	1
Distal radius external fixation	1
Distal radius ORIF	6
Emergency Carpal Tunnel Decompression after distal radius fixation	1
Phalanx ORIF	1
Interphalangeal finger joint reduction	3
Dorsal blocking k-wire for bony mallet injury	1
Dynamic Hip Screw	1
Cannulated hip screws	1
Midfoot ORIF	1
Wound suturing in ED	12
Total	**35**

Table 2. Procedures undertaken in patients sustaining tram related cycling injuries. Thirty two patients underwent 34 procedures.

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Conflict of Interest Form

COI form PHCS (completed).pdf